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ABSTRACTS FROM ASTRONOMICAL PUBLICATIONS.

In accordance with a recent arrangement the members of the scientific staff of the Lick Observatory hold meetings once per week, as an observatory duty, to report upon and discuss the more important articles appearing in the journals of astronomy, the important new books on astronomical subjects, or subjects of current and special interest in the observatory's work. It has been suggested that abstracts of the reports would be of interest to the readers of these Publications, and the Publication Committee has acted favorably upon the suggestion.

It is intended to preserve the qualities of abstracts as far as possible, and to restrict published criticisms, favorable or unfavorable, to a minimum.

THE REFLECTIVE POWER OF LAMP- AND PLATINUM-BLACK, BY T. ROYDS, M. SC.¹

The subject of this investigation is important to astrophysicists as dealing with a vital element of practically every instrument used for the measurement of radiation—that is the blackening substance with which the receiver of the apparatus is coated in order to secure complete absorption of the rays which are to be measured. Previous estimates of the amount of radiation reflected varied from 1 to 18 per cent of that incident on the blackened surface.

In the words of the author: "The method consists in measuring the galvanometer deflections, first when the rays fall directly on a thermopile, and then when they fall on the lamp- or platinum-black, the rays diffusely reflected from it being focused on a thermopile by means of a polished hemisphere of German silver." The arrangement of the apparatus is very ingenious and pains seem to have been taken to allow for practically all sources of error. The values of the reflectivity for radiations of various wave-lengths are as follows:—

Wave-length.	Lamp-black	Platinum-black	
	(0.205mm thick)	(deposited 15 mins.)	(deposited 3 mins.)
0.8 μ	1.13 %	0.17 %	1.30 %
8.7 μ	0.66	0.59	5.70
25.5 μ	0.67	0.93	7.08
51.0 μ	1.4	0.79	6.8
51.0 μ	1.6	1.1	7.4

The slightly discrepant values for 51 μ correspond to different methods used to isolate radiations of this wave-length.

¹ *Philosophical Magazine*, 21, 167, January, 1911.

The author takes occasion to correct certain physical constants, in the original determination of which the reflective power of platinum-black had been neglected.

W. H. WRIGHT.

THE SPECTRA OF SPIRAL NEBULÆ AND GLOBULAR STAR CLUSTERS, BY E. A. FATH.¹

This report covers an extension of Dr. FATH's work on the spectra of spiral nebulæ and star clusters originally undertaken during the period of his connection with the Lick Observatory. As the writer contemplates a more thorough investigation of the subject, with more efficient apparatus, it may suffice to say that the results are, in the main, confirmatory of the earlier work. The two spiral nebulæ examined appear to have solar spectra, while the globular clusters present spectra approximately of the F type.

W. H. WRIGHT.

The *Journal* of the Royal Astronomical Society of Canada for September-October, 1910, contains an article by PLASKETT entitled, "Slit Widths and Errors of Measurement in Radial Velocity Determinations." From forty-nine plates, twenty of which were taken with a one-prism spectroscope and twenty-nine with a three-prism, he finds the following probable errors:

MEAN PROBABLE ERRORS AS FUNCTIONS OF SLIT WIDTHS.				
Slit width	0.025mm	0.038mm	0.051mm	0.076mm
Single line	2.74km	2.31km	2.33km	3.49km
Single plate	1.65	1.44	1.62	3.47

Rigel was used as the star. The spectrograms were obtained with the region 4512 Å central, and in this region for this star several good lines are available. The difficulty of assigning wave-lengths to blends is avoided in this star. From these results it seems probable that very little or no accuracy is to be gained by using a slit width narrower than the minimum effective diameter of the star image on the slit.

R. YOUNG.

¹ Contribution from the Mt. Wilson Solar Observatory, No. 49; also *Astrophysical Journal*, **33**, 58, 1911.

ON THE PLACE OF COMETS IN COSMOGONY.

An interesting paper on this subject is given by Dr. E. STRÖMGREN in *Vierteljahrsschrift d. Astr. Gesellschaft*, Heft IV, 1910. It is, in brief, a summary of the investigations which have been made during the past fifteen years to determine by the methods of celestial mechanics whether comets are to be considered as members of our own solar system or visitors from interstellar space. Dr. STRÖMGREN has himself played no small part in securing the results which make it possible at last to give a definite answer to the problem, and anything from his pen may be taken as authoritative.

The fundamental question of comet cosmogony is this: Are comet orbits elliptic, parabolic, or hyperbolic? A glance at a catalogue of comet orbits will show, after subtracting a relatively small number of orbits of pronounced elliptic character, that a large proportion of the orbits remaining are practically parabolic, and a small number slightly hyperbolic. Were these facts to be taken at their face value, the probability would be very strong, as shown by SCHIAPARELLI, that most, or perhaps all, comets had come into our solar system from without in orbits originally hyperbolic. While some such hyperbolic comets would leave the system again never to return, in the course of ages sufficient would have their orbits slightly modified into long ellipses to show the state of affairs given in the list of comets which have appeared; namely, a large number of elliptic orbits nearly parabolic in nature, and a smaller number of slightly hyperbolic orbits.

The problem cannot properly be decided by a study of the eccentricities of comets as observed during the relatively short arc near perihelion when comets are visible, but the effect of the perturbations of the major planets must be calculated so as to determine as exactly as possible the eccentricity with which the comet entered our system, meaning by the latter phrase, its eccentricity when sufficiently remote to make the perturbations negligible. The first to attack this problem was THRAEN. Comet 1886 II showed a hyperbolic orbit during its apparition period, its eccentricity being 1.0002286 ± 0.0000044 . Reckoning back the effect of the perturbations due to *Jupiter* and

Saturn, THRAEN found the following decreasing values of the eccentricity :—

1885, Dec. 8	1.000229
1884, Aug. 15	1.000177
1883, Apr. 23	1.000052
1882, Oct. 5	1.000002

From these values he concluded that the eccentricity would sink below unity were the perturbations carried far enough back. STRÖMGREN carried through a similar research in the case of Comet 1890 II. In this case the computation of the earlier perturbations gave a value which appeared to converge at a point still slightly above unity. These difficulties led STRÖMGREN to a further study of the theoretical aspects of the problem, and in *Astronomische Nachrichten*, 4033-34, July, 1905, he derived a beautiful equation of great simplicity and rigor, which makes it possible to obtain the integrated maximum effect on the semi-major axis, and hence on the eccentricity, of all the perturbations previous to a given date. This date must be so chosen that the radius vector of the comet is considerably greater than that of the disturbing planet at this epoch, and back to this point the perturbations must be calculated by the ordinary methods, after which STRÖMGREN'S equation may be employed.

In 1906 FAYET published his great work, "Recherches Concernant les Excentricités des Comètes." In this work FAYET set himself the problem of calculating the earlier perturbations, in so far as they affected the eccentricity, of all comets whose orbits were of sufficient accuracy to make such computations of value, and whose orbits showed either hyperbolas or ellipses practically identical with parabolas. The lower limit which he set for the eccentricity was 0.9985. The labor of computing the perturbations for a large number of comets, carrying them back by mechanical quadratures ten or fifteen years before the time of apparition would have been prohibitive. FAYET accordingly developed methods by which the calculation of these perturbations could be made much more rapidly; while the method neglects a number of factors and the results lack complete rigor, they are sufficiently approximate to make the results entirely trustworthy for a study of cometary eccentricities be-

fore these bodies came under the perturbing influence of *Jupiter*. FAYET'S results may be summed up as follows:—

1. Of the 146 comets investigated, in only twenty-one cases was the eccentricity greater before coming into the zone of perturbative effect, and in only six of these cases was the amount noticeable.

2. Of twenty-four hyperbolic comets it was found that before the epoch of perturbations—

- 14 were elliptic,
- 9 were less hyperbolic,
- 1 had the same eccentricity.

3. Of twenty-three comets which were elliptic during their apparition period—

- 18 were more elliptic earlier,
- 5 were slightly less elliptic earlier, but none were hyperbolic.

4. Of ninety-nine parabolas, eighty-four were shown to be transformed ellipses. The other fifteen seemed to show a slightly hyperbolic orbit earlier, but the amount in each case was so small that it was of the same order of magnitude as the probable error of e furnished by the original computers of the orbits.

From these results FAYET postulates:—

1. That the perturbations have almost always had the effect of making cometary orbits more eccentric.
2. That practically all comets known possessed originally an elliptic orbit.
3. That for only four comets, 1844 III, 1863 VI, 1898 VII, and 1899 I, a more accurate calculation was needed.

In the case of Comet 1844 III he found a serious error in BOND'S original calculation; for the others he succeeded in showing that the eccentricity would probably be unity were the calculations carried sufficiently far back.

The last of these cases has now been removed by STRÖMGREN, who has shown that an exact calculation reduces the hyperbolicity to a point under the uncertainty of the given determination of the eccentricity.

The results of the labors of FAYET, FABRY, and STRÖMGREN may then be stated: Considering only the influence of Newtonian gravitation and introducing no other forces, all known comet orbits were doubtless originally ellipses; i. e. we are justified in assuming that the entire comet family are permanent members of our system and that none have come in from interstellar space. In conclusion STRÖMGREN draws attention to the need for future computers of definitive orbits themselves to calculate the effect of the earlier perturbations on the eccentricity (in cases where the eccentricity is close to parabolic), for without such calculations the orbits have little value for investigations in cosmogony. H. D. CURTIS.

A SUGGESTION TO MERIDIAN-CIRCLE OBSERVERS.

Under the caption "Standard Astrometry of the Future," Mr. W. ERNEST COOKE gives in *Astronomische Nachrichten*, 4470, the main features of the plan for international co-operation in meridian observations which was adopted at the Astrographic Conference held in Paris in April, 1909, and suggests that observers hereafter publish their observations in such form that anyone can easily reduce the given star places to the fundamental system of the future. This can best be done, he thinks, by printing as an appendix to each catalogue tables that will show upon what fundamental stars each observed star-place rests, and that will have blank columns in which the necessary corrections to the adopted positions of these fundamental stars can be entered.

Mr. COOKE has himself printed Volume IV of the Meridian Observations of the Perth Observatory on this plan. Examination of this volume shows that the catalogue and introduction fill sixty-three pages and the tables fifty-nine pages; that is, by this plan the size of the volume is practically doubled.

This raises again a point that is of growing importance, viz., the volume of astronomical publications. I think that astronomers in general, and particularly those who have to provide the ways and means for publishing and for shelving our volumes, are coming to the conviction that both observations and theoretical investigations should be printed in more concise form hereafter, more of the detail being taken on the responsibility of the writer. This would apply to meridian observations,

observations of double and variable stars, definitive comet orbits, etc. In the case now before us, would not all the requirements be satisfied if meridian observers adopted Mr. COOKE's excellent suggestion to the extent of forming such tables on cards to be kept at the observatory, but *not* published?

R. G. AITKEN.

THE ORBIT OF COMET 1886 I.

A paper with this title by ERICH REDLICH forms the principal article in Nos. 4477-78 of the *Astronomische Nachrichten*.

This comet gave the computers of its preliminary orbit much trouble from the fact that in the early part of its apparition the geocentric, or apparent motion, was very slow, and when AUGUST SVEDSTRUP undertook the investigation of a definitive orbit, from the 950 observations secured between the discovery date, December 1, 1885, and July 30, 1886, when it was last seen, he encountered even more serious difficulties. Following the ordinary methods in such investigations, he did, indeed, reach a solution that approximately represented the comet's motion throughout the opposition period, but the residuals from the observations in right ascension showed a systematic progression that was too definite to be ignored, and that SVEDSTRUP found it impossible to remove by any variations of the elements. He finally adopted the expedient of including the mass of the comet as one of the elements to be derived from his equation, and by this means arrived at satisfactory results so far as the residuals were concerned. The computation, however, indicated a *negative mass* for the comet, a result which could only be explained by assuming that the Sun had exercised a repulsive force upon it, which, in effect, had weakened its gravitative control.

SVEDSTRUP's work was not fully completed at the time of his death in 1893, and the results were not published until 1905. It does not appear that he considered his solution as definitive, and Professor THIELE, who published the work definitely, stated that a rediscussion of this orbit was desirable. For, while light pressure is generally accepted as at least one of the active agents in the formation of a comet's tail, its effect has been assumed to be too slight to affect the motion of the head or nucleus.

The problem, then, which REDLICH set for himself was this: If SVEDSTRUP's calculations are free from numerical errors, can the systematic progression of the residuals be removed without the assumption of the action of a repulsive force?

SVEDSTRUP's calculations were found to be very accurate, and his work was taken as the basis for the new investigation, the result of which is, briefly, that the troublesome residuals are entirely due to the systematic errors in the positions of the comparison-stars and to the personal equations of the observers of the comet. REDLICH enjoyed advantages denied to SVEDSTRUP in the investigation of the star-places, not only in having more and, for many stars, better catalogues at his disposal, but particularly in being able to reduce his stars to AUWERS's fundamental system. It developed that the southern star-places in general required an appreciable negative correction to reduce them to this system, and this correction accounted in part for the errors in the comet-places. REDLICH's discussion of the systematic errors of the observers of the comet is unusually elaborate, and his results are rather surprising. Not only are constant errors of considerable magnitude attributed to many observers, but in not a few cases it is found that these errors were not constant, but varied with the time, even having values of opposite sign at different periods. Thus, for BECKER's observations in right ascension at correction of $+0^s.29$ was adopted for February, 1886, and one of $-0^s.07$ after April 15th.

The general result of this new investigation is very satisfactory, but the question might, perhaps, be raised whether the refinements of computation are not carried to greater extremes than the observational data warrant. Thus REDLICH, following SVEDSTRUP, assigns weights to individual observations ranging from 0.1 to 2.0. It is doubtful whether it is possible to discriminate so nicely between different observations of a comet as to say definitely that one deserves the weight 0.3, while another should have weight 0.4. It may be questioned, also, whether the adopted systematic errors of the observers are in all cases real. The author, indeed, himself notes a number of them as doubtful.

R. G. AITKEN.

April, 1911.